CLAIMS

What is claimed is:

1. A method of generating an optimal path in a domain, comprising:

estimating a traffic volume of said domain;

constructing a traffic matrix in accordance with said estimated traffic volume;

computing a provisioning route for each non-zero element of said traffic matrix, wherein said method is performed for at least one class in descending order of priority, and said provisioning route is open to alteration; and

readjusting said traffic matrix in response to said computed provisioning route.

2. The method of claim 1, wherein said domain comprises one of an IP backbone network and a network having a plurality of core nodes connected via logical links to gateway nodes of neighboring domains and at least one bypass node connected to at least one of said core nodes.

3. The method of claim 1, further comprising evaluating cost benefits of reversing a path of at least one previously provisioned flow.

4. The method of claim 1, further comprising maximizing a traffic acceptance rate, and minimizing a hop-bandwidth product.

5. The method of claim 1, said computing step comprising:

listing and sorting all quadruplets for said at least one class, wherein each of said quadruplets comprises a path having a source, a destination, a rate between said source and said destination, and an indicator of path alterability;

selecting a first quadruplet that has not been rejected; and

computing an optimal path between said source and said destination on a subnetwork that comprises all paths meeting bandwidth availability requirements for said first quadruplet, said computing step comprising one of (i) accepting a shortest available path for said first quadruplet if a sub-optimality cost of said first quadruplet equals zero, and (ii) performing a backtracking step to determine if an ideal shortest path of said first quadruplet is feasible if said sub-optimality cost of said first quadruplet is greater than zero.

6. The method of claim 5, said computing step further comprising:

calculating said ideal shortest path and a number of hops in said ideal shortest path H for said first quadruplet;

calculating said shortest available path and a number of hops in said shortest available path H* for said first quadruplet; and

calculating said sub-optimality cost in accordance with the rate, said H and said H*.

7. The method of claim 5, said backtracking step comprising:

creating a matrix that comprises a previous quadruplet configured for alteration and having all links between said source and said destination of said previous quadruplet in said subnetwork;

one of (i) accepting said available shortest path of said first quadruplet if said matrix is empty, (ii) calculating a minimum value of a shifting cost of said previous quadruplet in accordance with said rate of said previous quadruplet in said subnetwork and a difference between a number of hops in said current path and said altered path for said previous quadruplet in said matrix and if said matrix is not empty, and (iii) accepting said available shortest path if said minimum shifting cost of said previous quadruplet exceeds said sub-optimality cost of said

first quadruplet, wherein said altered path for said previous quadruplet is generated by deleting said previous quadruplet and adding said first quadruplet; and

if said minimum shifting cost for said first quadruplet exceeds said sub-optimality cost for said previous quadruplet, (i) routing said previous quadruplet on a new path and resetting said available shortest path for said previous quadruplet to said new path, (ii) routing said first quadruplet on said shortest ideal path for said first quadruplet and (iii) resetting said available shortest part to said shortest ideal path for said first quadruplet, and configuring said first quadruplet to not be altered.

8. The method of claim 5, further comprising

selecting a highest non-selected class from a plurality of differentiated service classes; and

adjusting bandwidth availability of said network in accordance with said optimal path of said first quadruplet.

9. The method of claim 1, wherein said readjusting step comprises adjusting one of bandwidth availability wherein said domain comprises a Diffserv network, and optical wavelengths where said domain comprises an optical network.

10. A method of calculating an optimal path of a network, comprising:

selecting a highest non-selected class from a plurality of differentiated service classes;

listing all quadruplets for said selected class, wherein each of said quadruplets comprises a path having a source, a destination, a rate between said source and said destination, and an indicator of path alterability, wherein said quadruplets are sorted according to said rate;

selecting a first quadruplet that has not been rejected;

computing an optimal path between said source and said destination on a subnetwork of said network that comprises all paths meeting bandwidth availability requirements for said first quadruplet, said computing step comprising,

calculating an ideal shortest path and a number of hops in said ideal shortest path H for said first quadruplet,

calculating a shortest available path and a number of hops in said shortest available path H^* for said first quadruplet,

calculating a sub-optimality cost in accordance with the rate, said H and said H^*, and

one of accepting said shortest available path for said first quadruplet if said sub-optimality cost of said first quadruplet equals zero, and performing backtracking to determine if said ideal shortest path of said first quadruplet is feasible if said sub-optimality cost of said first quadruplet is greater than zero, said backtracking step comprising,

creating a matrix that comprises a previous quadruplet configured for alteration and having all links between said source and said destination of said previous quadruplet in said subnetwork;

one of (i) accepting said available shortest path of said first quadruplet if said matrix is empty, (ii) calculating a minimum value of a shifting cost of said previous quadruplet in accordance with said rate of said previous quadruplet in said subnetwork and a difference between a number of hops in said current path and said altered path for said previous quadruplet in said matrix and if said matrix is not empty, and (iii) accepting said available shortest path if said minimum

shifting cost of said previous quadruplet exceeds said sub-optimality cost of said first quadruplet, wherein said altered path for said previous quadruplet is generated by deleting said previous quadruplet and adding said first quadruplet, and

if said minimum shifting cost for said first quadruplet exceeds said sub-optimality cost for said previous quadruplet, routing said previous quadruplet on a new path P^* and resetting said available shortest path for said previous quadruplet to said new path P^*, routing said first quadruplet on said shortest ideal path for said first quadruplet and resetting said available shortest part to said shortest ideal path for said first quadruplet, and configuring said first quadruplet to not be altered; and

adjusting bandwidth availability of said network in accordance with said optimal path of said first quadruplet.

11. A network for path provisioning of an SLA, comprising:

a plurality of edge nodes that one of receive and transmit a prescribed amount of traffic in accordance with said SLA; and

a plurality of links that couple receiving and transmitting edge nodes to one another, each of said links having a maximum capacity, wherein an optimal path is calculated for a current suboptimal path by resetting a previously calculated path if a cost of said resetting step for said previously calculated path is less than a cost of suboptimality for said current suboptimal path.

12. The network of claim 11, wherein said network comprises a Diffserv network and said capacity comprises bandwidth.

13. The network of claim 11, wherein said network comprises an optical network, and said capacity comprises optical wavelengths.

14. The network of claim 11, said network comprising one of an IP backbone network and a network having a plurality of core nodes connected via logical links to gateway nodes of neighboring domains, and at least one bypass node connected to at least one of said core nodes.

15. The network of claim 11, wherein one of said edge nodes comprises an ingress router.

16. The network of claim 15, wherein a program in said ingress router performs the steps of:

estimating a traffic volume of said domain;

constructing a traffic matrix in accordance with said estimated traffic volume;

computing a provisioning route for each non-zero element of said traffic matrix, wherein said method is performed for at least one class in descending order of priority, and said provisioning route is open to alteration; and

readjusting said traffic matrix in response to said computed provisioning route.

17. The network of claim 16, wherein said program in said ingress router further performs said computing step as follows:

sorting all quadruplets for said at least one class, wherein each of said quadruplets comprises a path having a source, a destination, a rate between said source and said destination, and an indicator of path alterability;

selecting a first quadruplet that has not been rejected;

computing an optimal path between said source and said destination on a subnetwork that comprises all paths meeting bandwidth availability requirements for said first quadruplet, said

computing step comprising one of (i) accepting a shortest available path for said first quadruplet if a sub-optimality cost of said first quadruplet equals zero, and (ii) performing backtracking to determine if an ideal shortest path of said first quadruplet is feasible if said sub-optimality cost of said first quadruplet is greater than zero.

18. The network of claim 17, wherein said ingress router performs the following steps:

calculating said ideal shortest path and a number of hops in said ideal shortest path H for said first quadruplet;

calculating said shortest available path and a number of hops in said shortest available path H^* for said first quadruplet; and

calculating said sub-optimality cost in accordance with the rate, said H and said H^*.

19. The network of claim 17, wherein said ingress router performs the following steps:

creating a matrix that comprises a previous quadruplet configured for alteration and having all links between said source and said destination of said previous quadruplet in said subnetwork;

one of (i) accepting said available shortest path of said first quadruplet if said matrix is empty, (ii) calculating a minimum value of a shifting cost of said previous quadruplet in accordance with said rate of said previous quadruplet in said subnetwork and a difference between a number of hops in said current path and said altered path for said previous quadruplet in said matrix and if said matrix is not empty, and (iii) accepting said available shortest path if said minimum shifting cost of said previous quadruplet exceeds said sub-optimality cost of said

first quadruplet, wherein said altered path for said previous quadruplet is generated by deleting said previous quadruplet and adding said first quadruplet; and

if said minimum shifting cost for said first quadruplet exceeds said sub-optimality cost for said previous quadruplet, routing said previous quadruplet on a new path P^* and resetting said available shortest path for said previous quadruplet to said new path P^*, routing said first quadruplet on said shortest ideal path for said first quadruplet and resetting said available shortest part to said shortest ideal path for said first quadruplet, and configuring said first quadruplet to not be altered.

20. The network of claim 17, wherein said ingress router performs the following steps:

selecting a highest non-selected class from a plurality of differentiated service classes;

adjusting bandwidth availability of said network in accordance with said optimal path of said first quadruplet.